PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PU030249	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/US2004/025366	International filing date *(day/month/year)* 04.08.2004	Priority date *(day/month/year)* 20.08.2003
International Patent Classification (IPC) or national classification and IPC H04N7/26		
Applicant THOMSON LICENSING S.A. et al.		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 9 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *sent to the applicant and to the International Bureau)* a total of 5 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

☒	Box No. I	Basis of the opinion
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

Date of submission of the demand	Date of completion of this report
05.05.2005	09.12.2005
Name and mailing address of the international preliminary examining authority: European Patent Office - Gitschiner Str. 103 D-10958 Berlin Tel. +49 30 25901 - 0 Fax: +49 30 25901 - 840	Authorized Officer Heising, G Telephone No. +49 30 25901-407

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/US2004/025366

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
   - ☐ international search (under Rules 12.3 and 23.1(b))
   - ☐ publication of the international application (under Rule 12.4)
   - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-5 as originally filed

Claims, Numbers

1-32 received on 12.05.2005 with letter of 05.05.2005

Drawings, Sheets

1/2, 2/2 as originally filed

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	4-6,8,10,13,14,16,19,21-23,26,28,29,31
	No:	Claims	1-3,7,9,11,12,15,17,18,20,24,25,27,30,32
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-32
Industrial applicability (IA)	Yes:	Claims	1-32
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V.

The following documents are referred to in this communication, the documents D5 was not cited in the international search report.

D1 : CHRISTINA GOMILA, ALEXANDER KOBILANSKY: "SEI message for film grain encoding" JVT OF ISO IEC MPEG AND ITU-T VCEG JVT-H022, 23 May 2003 (2003-05-23), pages 1-14, XP002308742 GENEVA, SWITZERLAND

D2 : SCHOYER M K N ET AL: "Block position dithering in DCT-coded sequences" SIGNAL PROCESSING. IMAGE COMMUNICATION, ELSEVIER SCIENCE PUBLISHERS, AMSTERDAM, NL, vol. 8, no. 6, September 1996 (1996-09), pages 545-549, XP004047116 ISSN: 0923-5965

D3: US-A-5 450 098 (OZ RAN) 12 September 1995 (1995-09-12)

D4: J.-R. OHM: "Digitale Bildcodierung, Statistische und Inhaltsorientierte Bildmodelle (Kapitel 4.1-4.2)" 1995, SPRINGER-VERLAG , BERLIN HEIDELBERG NEW YORK , XP002309350

D5: GISLE BJONTEGAARD: "Addition of comfort noise as post processing" ITU-T SG 16, Video Coding Experts Group, Document Q15B15, 8 September 1997, pages 1-2, XP002319278, SUNRIVER, OREGON, USA

1 CLARITY

Please note, that for some expressions in the claims it is not clear to which features they relate, thus they are not considered during the following examination. These expressions are set in square brackets throughout this written opinion.

2 INDEPENDENT CLAIM 1

The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 1 is not new in the sense of Article 33(2) PCT.
Document D1 discloses (the references in parenthesis applying to this document):

A method for reducing artifacts in a video stream

(*D1: page 2, paragraph 2 and 3, wherein the artifacts are the missing film grain in the decoded images; please note, that any difference between the original input image (including film grain noise) and the decoded output image (with reduced film grain noise) can be seen as a coding artifact, thus the addition of film grain noise to the decoded output image is a method for reducing these artifacts*),
comprising the steps of: decoding the video stream
(*D1: figure 1, "Decoding"*);
and adding noise to at least one pixel in a picture in the video stream following decoding
(*D1: figure 1, "Film grain simulation" with page 3, section "film grain simulation (decoder)" and page 5, lines 13-15, including equation 1*)
in an amount correlated to additive noise of pixels in at least one prior picture
(*D1: page 5, lines 22-26 and page 6, lines 6-11 including equation 3: with a temporal correlation factor v. Thus, the noise to be added to a pixel in the current image G(x,y,t,L) is correlated by a correlation factor v(c,L) with the noise G(x,y,t-1,L) added to a decoded pixel in a previous decoded image at time t-1 and with intensity L.*).

3 INDEPENDENT CLAIM 11

The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 11 is not new in the sense of Article 33(2) PCT.
Compared to claim 1 only the feature of "in an amount correlated to additive noise of pixels in at least one prior picture" is replaced in claim 11 by "in an amount correlated to additive noise of at least one other pixel in the picture".
Document D1 discloses this feature as well (*D1: page 5, lines 22-36 including equation 2: with spatial correlation factors q, r, s, correlating the noise added previously to neighbouring pixels to the noise of the current pixel*).

Document D5, which has been added by the Examiner, discloses all the features of claim 11 as well (*D5: whole page 1, wherein the comfort noise value (I_2) added to a current pixel is correlated to the noise added to pixels at position current-2 by the value R_{-2}*).

4 INDEPENDENT CLAIM 12

The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 12 is not new in the sense of Article 33(2) PCT.
Document D1 discloses (the references in parenthesis applying to this document):

A decoder arrangement for decoding a coded video stream to yield reduced artifacts,
(*D1: page 2, paragraph 2 and 3, wherein the artifacts are the missing film grain in the decoded images*)
comprising: a video decoder for decoding an incoming coded video stream to yield decoded pictures
(*D1: figure 1, "Decoding"*)
a reference picture store for storing at least one previously decoded picture for use by the decoder in decoding future pictures,
(*D1: page 8, paragraph 4 and 5 "JM6.1a encoder" settings with "Number of reference frames: 2", thus the used corresponding decoder must have (implicitly) a reference picture store as well, if it will be able to decode the bitstream*)
a noise generator [noise] for generating noise for addition to at least one pixel in a decoded picture
(*D1: figure 1, "Film grain simulation" with page 3, section "film grain simulation (decoder)" and page 5, lines 13-15, including equation 1*)
in an amount correlated to additive noise of at least one pixel in at least one prior picture;
(*D1: page 5, lines 22-26 and page 6, lines 6-11 including equation 3: with a temporal correlation factor v. Thus, the noise to be added to a pixel in the current image G(x,y,t,L) is correlated by a correlation factor v(c,L) with the noise G(x,y,t-1,L) added to a decoded pixel in a previous decoded image at time t-1 and with intensity L.*)
a summing block for summing the noise generated by the noise generator with a decoded picture from the decoder
(*D1: "+" in equations 1, 2 and 3*);
and a clipper for clipping the summed noise and decoded picture.
(*D1: a clipper is (implicitly) present in the scheme of D1: Since Gaussian noise of predetermined variance, i.e. without restriction to the maximum value of the noise amplitude, is added to the decoded pictures, it would have led to strong visible artifacts in dark and light regions of the output images, if they had not been clipped.*

As no such artifacts are visible in the images of figure 8 in D1 a clipper was used)

5 INDEPENDENT CLAIM 20

The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 20 is not new in the sense of Article 33(2) PCT.

Compared to claim 12 only the feature of "for addition to at least one pixel in decoded picture in an amount correlated to additive noise of at least one pixel in at least one prior picture" is replaced in claim 20 by "in accordance with decoded pictures and bit stream information from the decoder for addition to at least one pixel [in decoded] in an amount correlated to additive noise of at least one pixel in a prior picture".

Document D1 discloses this feature as well (*D1: page 5, lines 7-15 including equations 1 and 3 with L representing the dependency of the added noise G(L) on the decoded images and "SEI parameters" being the bit stream information, page 6, lines 6-11 and equation 3: with temporal correlation factor v correlating the noise added to a previous picture t-1 to the noise of the pixel in the current frame t).*

6 INDEPENDENT CLAIM 27

The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 27 is not new in the sense of Article 33(2) PCT.

Compared to claim 12 the feature of

"for addition to at least one pixel in decoded picture in an amount correlated to additive noise of at least one pixel in at least one prior picture"

is replaced in claim 27 by

"for addition to at least one pixel in a decoded picture in an amount correlated to additive noise of pixels in a prior picture".

Furthermore, the additional feature of claim 17 is added in claim 27 as well:

"including a noise picture store for storing the noise information for subsequent use by the noise generator.

Document D1 discloses these two features as well (*D1: page 6, equation 3 wherein noise for addition to two pixels G(x,y,c,t,L) and G(x+1,y,c,t,L) is correlated to additive noise of two pixels in a prior picture G(x,y,c,t-1,L) and G(x+1,y,c,t-1,L). Furthermore,*

a noise picture store is implicitly used in the temporal recursive noise generator of D1, equation 3, because, without such a memory, for every pixel the whole recursive noise calculation starting with the first image up to the current one had to be performed again and again which would have let to an enormous increase of the computational complexity. Furthermore, it is the nature of a recursive formula to reuse already calculated values which, therefore, have to be stored.).

7 INDEPENDENT CLAIM 32

The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 32 is not new in the sense of Article 33(2) PCT.
Compared to claim 12 only the feature of "in an amount correlated to additive noise of at least one pixel in at least one prior picture" is replaced in claim 32 by "in an amount correlated to additive noise of at least one pixel in the picture".
Document D1 discloses this feature as well (*D1: page 5, lines 22-36 including equation 2: with spatial correlation factors q, r, s, correlating the noise added previously to neighbouring pixels to the noise of the current pixel*).

8 NOVELTY, DEPENDENT CLAIMS 2,3,7,9,15,17,18,24,25 AND 30

Dependent claims 2,3,7,9,15,17,18,24,25 and 30 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and inventive step (Article 33(2) and (3) PCT), see documents D1-D5 and the corresponding passages cited in the search report.

9 INVENTIVE STEP, DEPENDENT CLAIMS 4-6,8,10,13,14,16,19,21-23,26,28,29 AND 31

Dependent claims 4-6,8,10,13,14,16,19,21-23,26,28,29 and 31 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step (Article 33(3) PCT), see documents D1-D5 and the corresponding passages cited in the search report.

10 CLAIMS 1-32

Claims 1-32 disclose methods and apparatus for video decoding and post-processing applications. Therefore, the subject-matter of these claims is considered to be industrially applicable according to Article 33 (4) PCT.

1. A method for reducing artifacts in a video stream, comprising the steps of:
decoding the video stream; and
adding noise to at least one pixel in a picture in the video stream following decoding in an amount correlated to additive noise of pixels in at least one prior picture.

2. The method according to claim 1 wherein the at least one prior picture comprises a previously displayed picture.

3. The method according to claim 1 where the at least one prior picture comprises a previously decoded picture

4. The method according to claim 1 wherein the amount of noise is correlated in accordance with a correlation factor α having a value such that $0 \leq \alpha \leq 1$.

5. The method according to claim 1 wherein the amount of noise is correlated using an instantiation of a Finite Impulse Response (FIR) filter.

6. The method according to claim 1 wherein the amount of noise is correlated using an approximation of an Infinite Impulse Response (IIR) filter.

7. The method according to claim 1 further comprising the steps of:
extracting bit stream information from the video stream; and
determining strength of the added noise in accordance with the bit stream information.

8. The method according to claim 7 wherein the bit stream information comprises a quantization parameter.

9. The method according to claim 1 wherein the added noise is Gaussian noise.

10. The method according to claim 1 wherein the added noise is Laplacian noise.

11. A method for reducing artifacts in a video stream, comprising the steps of:
decoding the video stream; and
adding noise to at least one pixel in a picture in the video stream following decoding in an amount correlated to additive noise of at least one other pixel in the picture.

12. A decoder arrangement for decoding a coded video stream to yield reduced artifacts, comprising:
a video decoder for decoding an incoming coded video stream to yield decoded pictures ;
a reference picture store for storing at least one previously decoded picture for use by the decoder in decoding future pictures,
a noise generator noise for generating noise for addition to at least one pixel in a decoded picture in an amount correlated to additive noise of at least one pixel in at least one prior picture;
a summing block for summing the noise generated by the noise generator with a decoded picture from the decoder; and
a clipper for clipping the summed noise and decoded picture.

13. The decoder arrangement according to claim 12 wherein the noise generator implements an instantiation of a Finite Impulse Response filter.

14. The decoder arrangement according to claim 12 wherein the noise generator implements an approximation of an Infinite Impulse Response filter.

15. The decoder arrangement according to claim 12 wherein the noise generator generates noise in accordance with decoded pictures and bit stream information supplied from the decoder.

16. The decoder arrangement according to claim 15-wherein the bit stream information comprises a quantization parameter.

17. The decoder arrangement according to claim 12 further including a noise picture store for storing the noise information for subsequent use by the noise generator.

18. The decoder arrangement method according to claim 12 wherein the noise generator adds Gaussian noise.

19. The decoder arrangement method according to claim 12 wherein the noise generator adds Laplacian noise.

20. A decoder arrangement for decoding a coded video stream to yield reduced artifacts, comprising:

a video decoder for decoding an incoming coded video stream to yield decoded pictures ;

a reference picture store for at least one storing at least one previously decoded picture for use by the decoder in decoding future pictures,

a noise generator noise for generating noise in accordance with decoded pictures and bit stream information from the decoder for addition to at least one pixel in decoded in an amount correlated to additive noise of at least one pixel in a prior picture;

a summing block for summing the noise generated by the noise generator with a decoded picture from the decoder; and

a clipper for clipping the summed noise and decoded picture .

21. The decoder arrangement according to claim 20 wherein the bit stream information comprises a quantization parameter.

22. The decoder arrangement according to claim 20 wherein the noise generator implements an instantiation of a Finite Impulse Response filter.

23. The decoder arrangement according to claim 20 wherein the noise generator implements an approximation of an Infinite Impulse Response filter.

24. The decoder arrangement according to claim 20 further including a noise picture store for storing the noise information for subsequent use by the noise generator.

25. The decoder arrangement method according to claim 20 wherein the noise generator adds Gaussian noise.

26. The decoder arrangement method according to claim 20 wherein the noise generator adds Laplacian noise.

27. A decoder arrangement for decoding a coded video stream to yield reduced artifacts, comprising:

a video decoder for decoding an incoming coded video stream to yield decoded pictures ;

a reference picture store for at least one storing picture previously decoded by the decoder for use by the decoder in decoding future pictures,

a noise generator noise for generating noise for addition to at least one pixel in a decoded picture in an amount correlated to additive noise of pixels in a prior picture;

a noise picture store for storing the noise information for subsequent use by the noise generator;

a summing block for summing the noise generated by the noise generator with a decoded picture from the decoder;

a clipper for clipping the summed noise and decoded picture.

28. The decoder arrangement according to claim 27 wherein the noise generator implements an instantiation of a Finite Impulse Response filter.

29. The decoder arrangement according to claim 27 wherein the noise generator implements an approximation of an Infinite Impulse Response filter.

30. The decoder arrangement method according to claim 27 wherein the noise generator adds Gaussian noise.

31. The decoder arrangement method according to claim 27 wherein the noise generator adds Laplacian noise.

32. A decoder arrangement for decoding a coded video stream to yield reduced artifacts, comprising:

a video decoder for decoding an incoming coded video stream to yield decoded pictures ;

a reference picture store for storing at least one previously decoded picture for use by the decoder in decoding future pictures,

a noise generator noise for generating noise for addition to at least one pixel in a decoded picture in an amount correlated to additive noise of at least one pixel in the picture;

a summing block for summing the noise generated by the noise generator with a decoded picture from the decoder; and

a clipper for clipping the summed noise and decoded picture.